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(54) LOAD ADJUSTMENT DEVICE

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(58) **Field of Search** 123/361, 396, 123/399, 400

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(57) **ABSTRACT**

A load adjustment apparatus for an internal combustion engine has a torsion spring **(4)** which is attached in a positively locking manner to a control shaft **(3)** for a throttle valve and a supporting part **(2)**. At one end, the torsion spring **(4)** is bent in a U-shape in order to engage around a pin **(17)** of the supporting part **(2)**, and has a spring tongue **(16)** which points in the direction of the base of the U. For mounting, the open end of the U of the torsion spring **(4)** is pressed over the pin **(17)** until the spring tongue **(16)** snaps in behind the pin **(17)**. The torsion spring **(4)** is then connected in a positively locking manner to the pin **(17)** and can transmit forces in both rotation directions to the control shaft **(3)**.

18 Claims, 3 Drawing Sheets

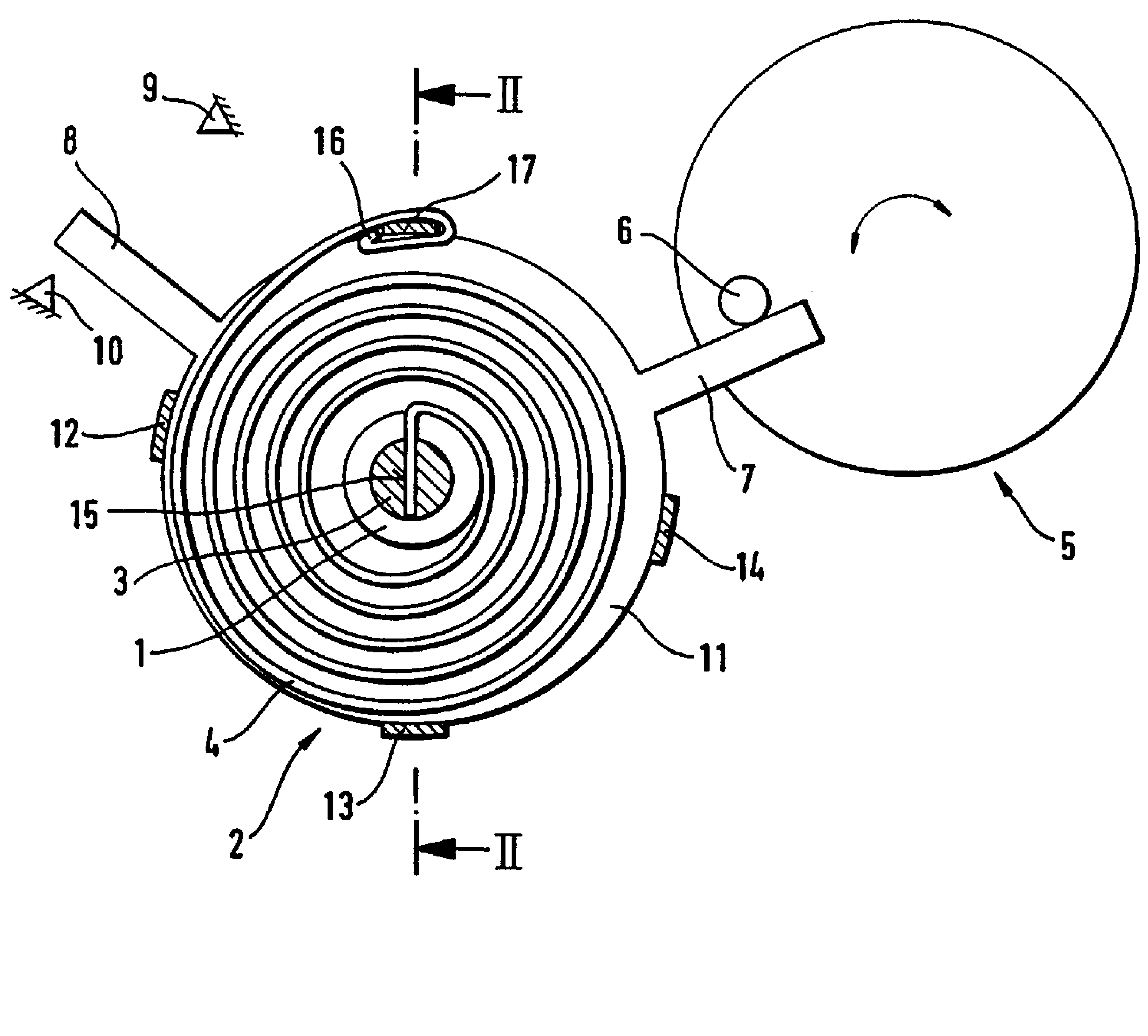


Fig. 1

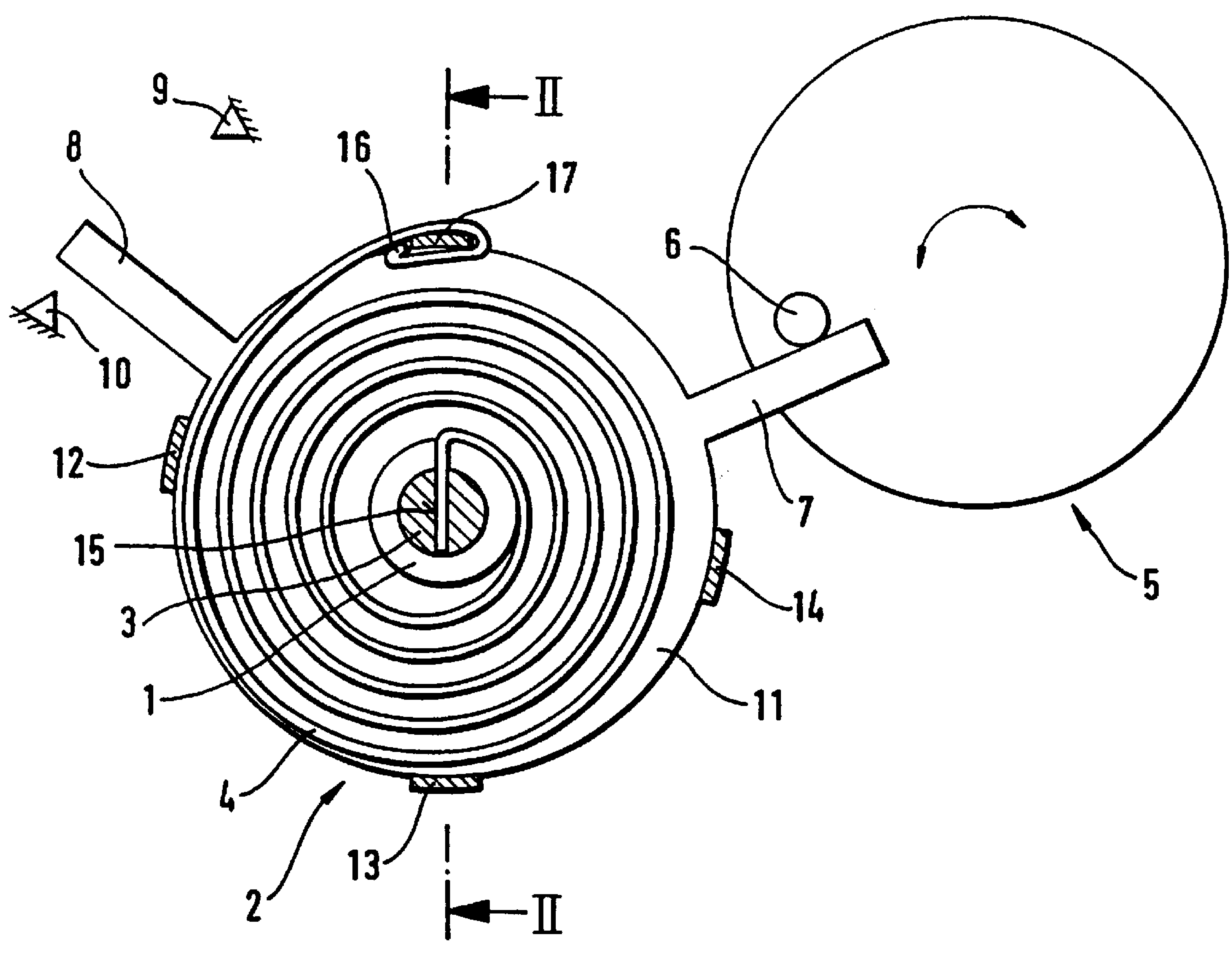


Fig. 2

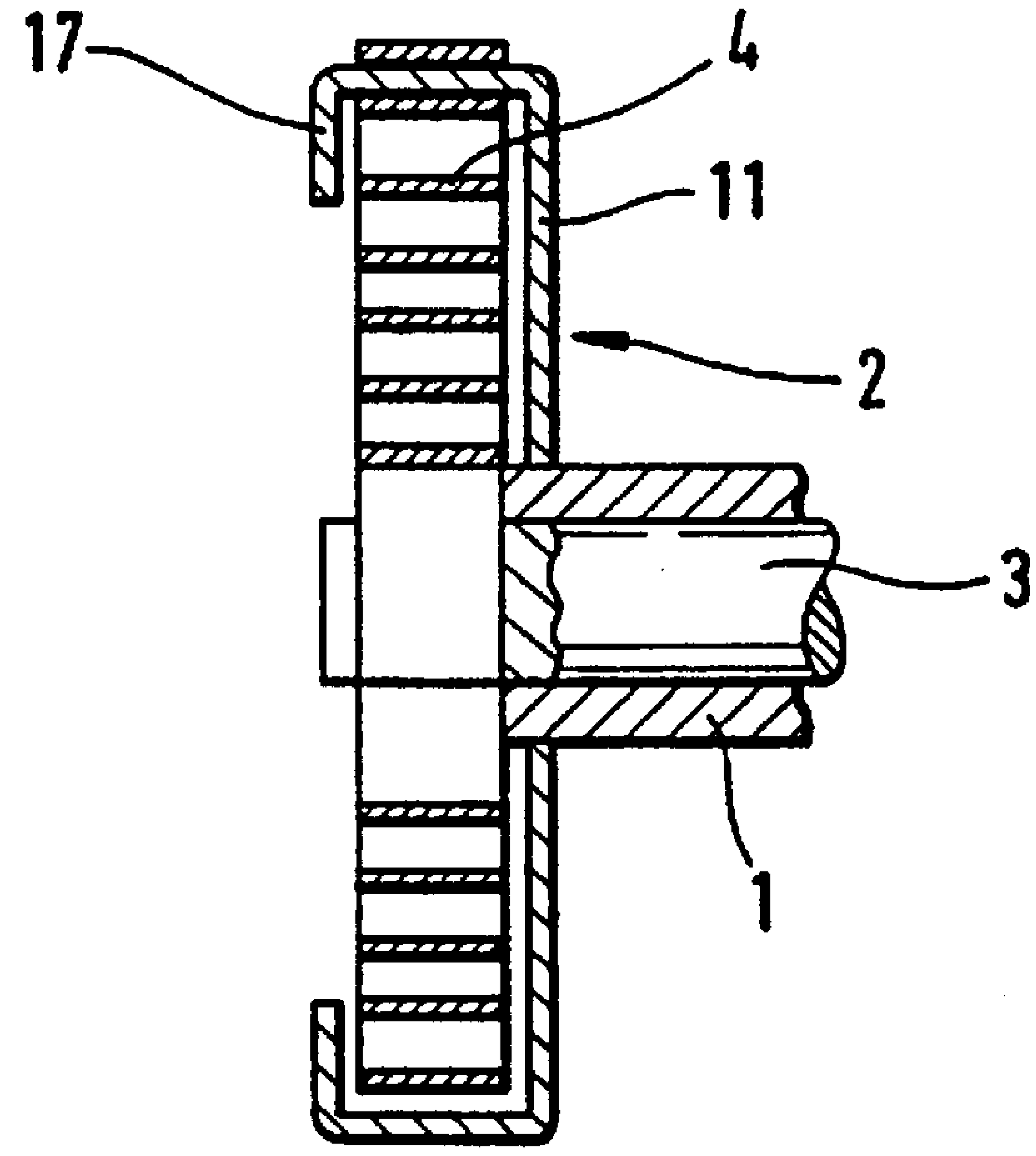


Fig. 3

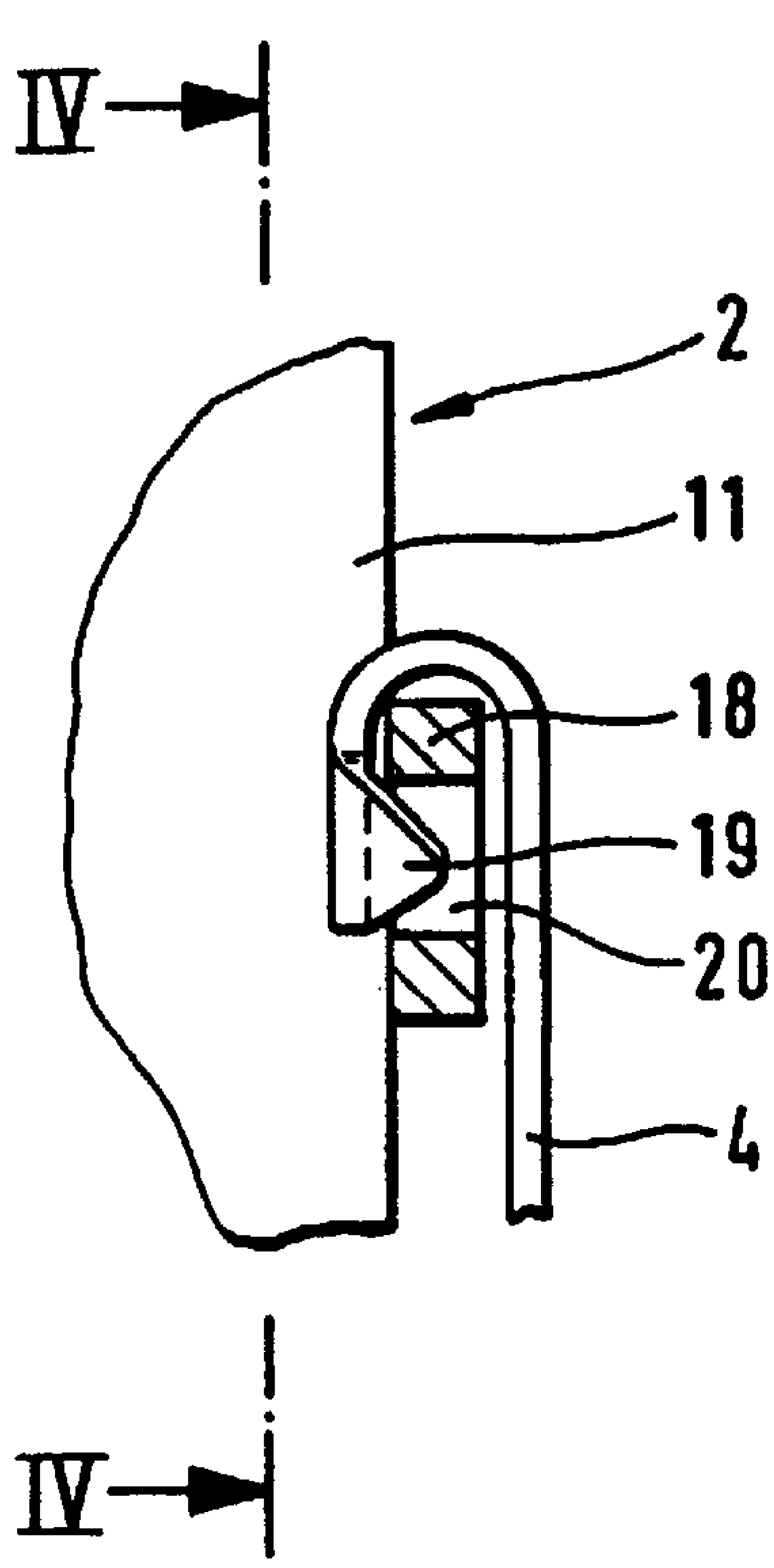


Fig. 4

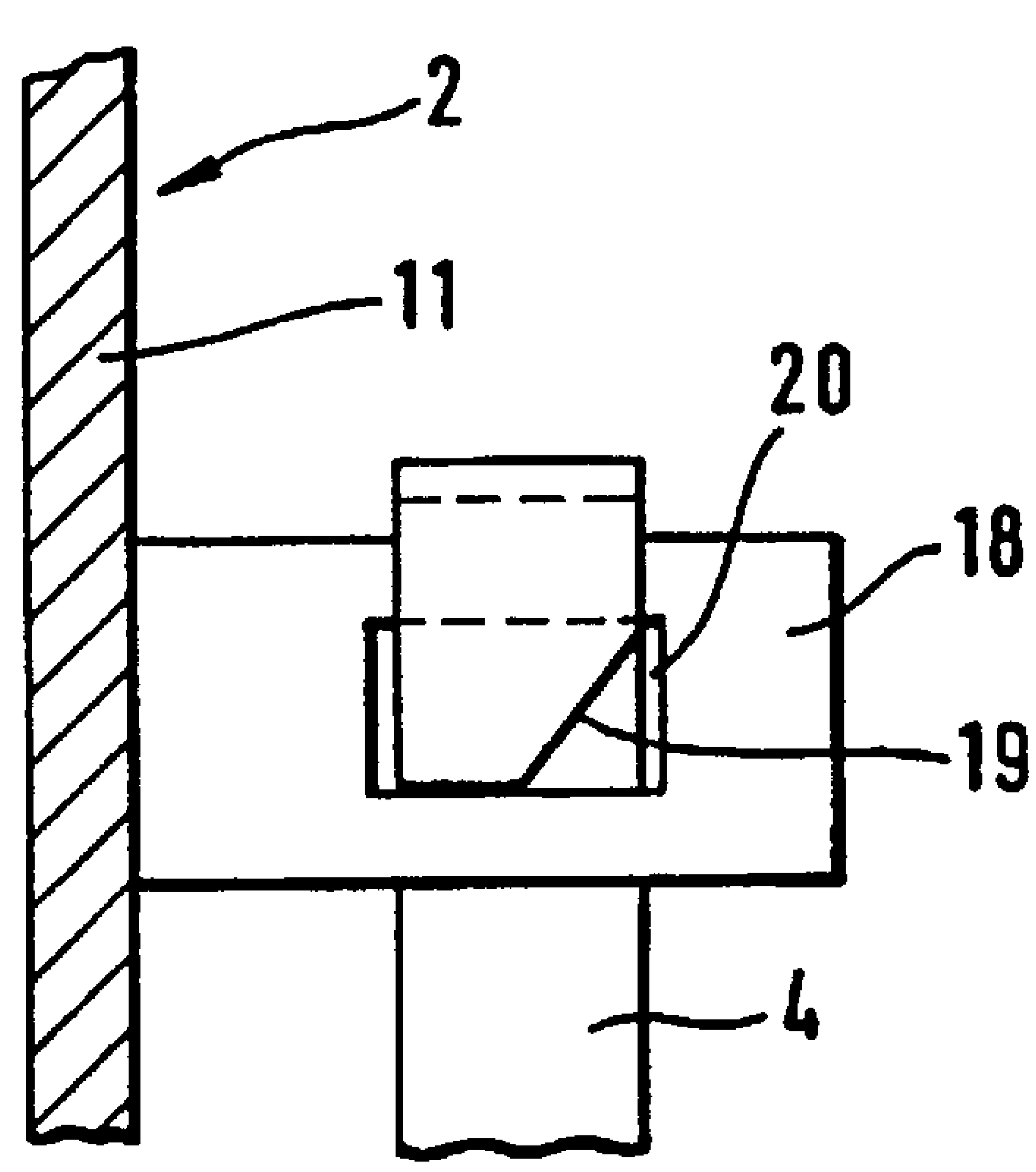


Fig. 5

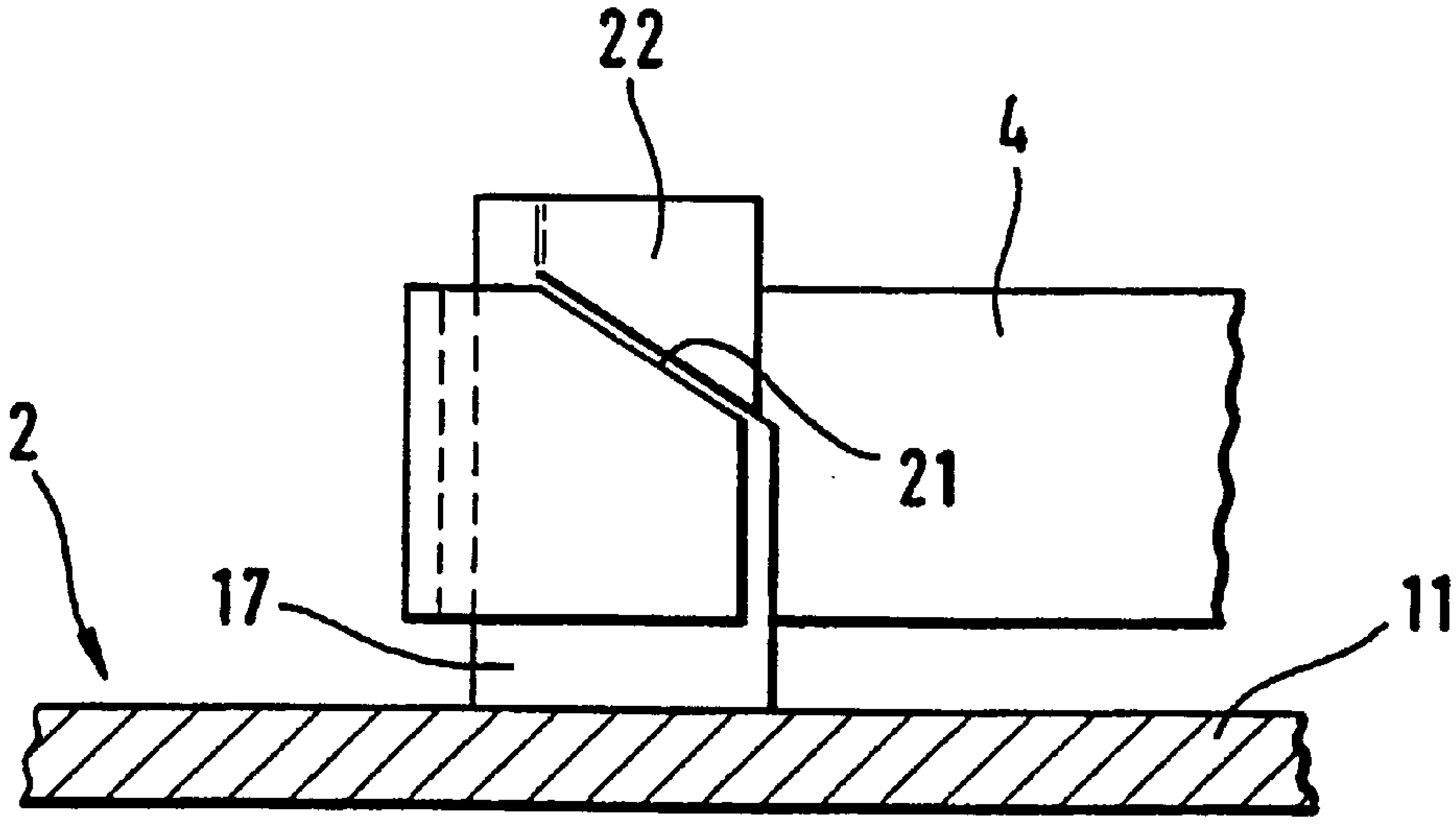
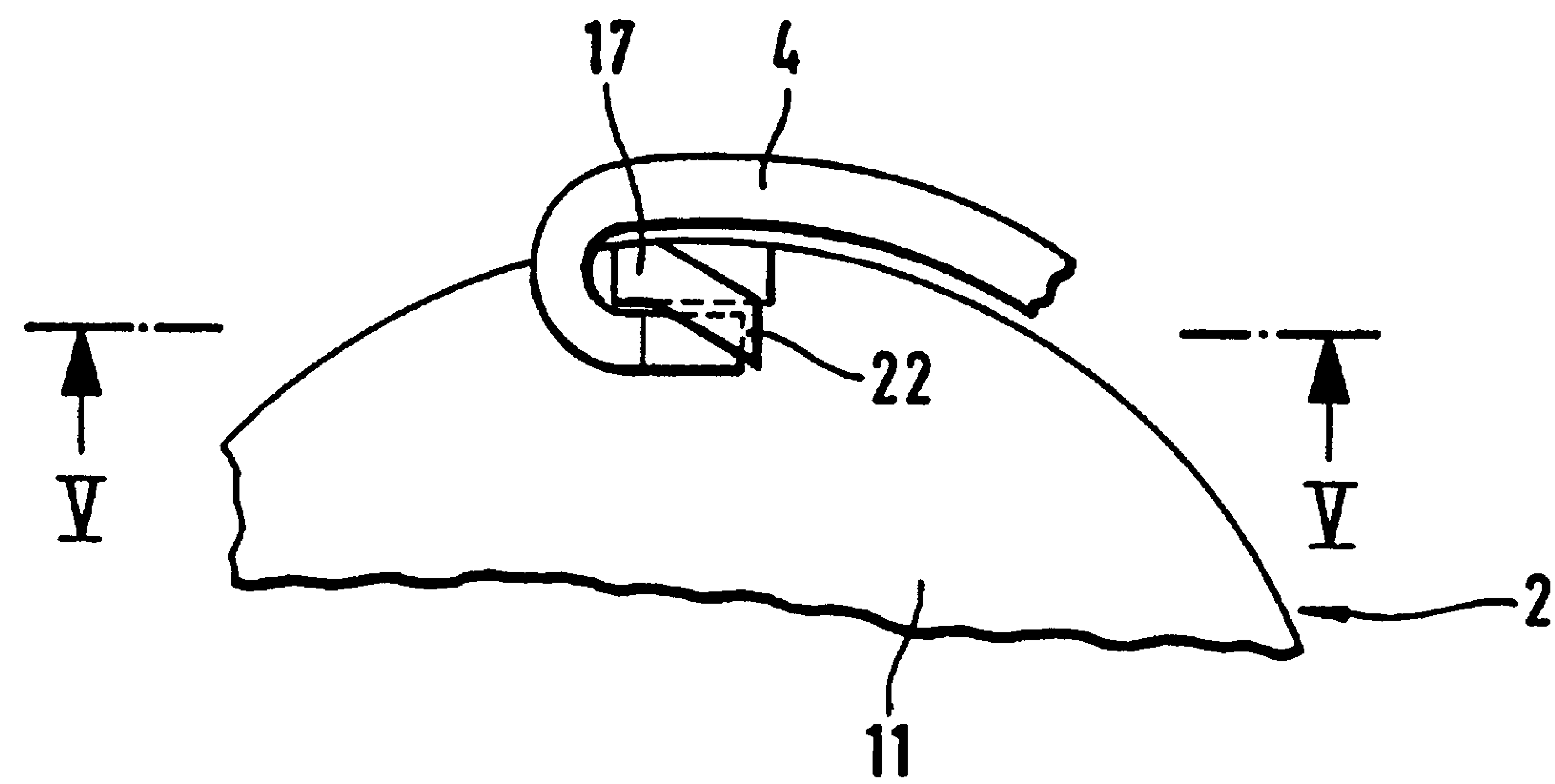


Fig. 6



LOAD ADJUSTMENT DEVICE

FIELD AND BACKGROUND OF THE INVENTION

The invention relates to a load adjustment apparatus having an actuating element which controls the power of an internal combustion engine, is designed in particular as a throttle valve and is arranged on a control shaft, in which case the control shaft can be driven by means of a reversible actuating drive such that it can pivot between a minimum load position and a full load position, and having a single torsion spring, which is designed as a return spring to prestress the control shaft in the minimum load direction and as an emergency running spring to prestress the control shaft against an emergency running stop, the first end of which torsion spring is connected or can be connected to the control shaft while its second end is connected or can be connected to an arm of a supporting part which can move between a minimum load stop and the emergency running stop.

Load adjustment apparatuses of the type mentioned above are known in general by the name E-Gas, for adjusting the power of internal combustion engines in motor vehicles. By using a single torsion spring as an emergency running spring and as a return spring, the load adjustment apparatus has a particularly compact design, and is particularly light in weight.

A disadvantage of the known load adjustment apparatus is that the ends of the torsion spring must be attached in a complex manner to the control shaft and to the supporting part, since the torsion spring exerts actuating forces which act in both rotation directions of the control shaft. Furthermore, vibration in the motor vehicle can lead to the attachment of the torsion spring becoming loose. As a rule, the control shaft has a slot, into which the torsion spring is inserted, in order to attach the torsion spring to the control shaft.

It would be feasible to screw the second end of the torsion spring firmly to the supporting part. However, a load adjustment apparatus designed in such a way would be particularly costly. Furthermore, vibration can cause a screw to become loose, so that the torsion spring would then no longer be connected to the supporting part.

SUMMARY OF THE INVENTION

The invention is based on the objective of providing a load adjustment apparatus of the type mentioned initially such that it can be constructed particularly cost-effectively, and such that the torsion spring is attached to the supporting part in a particularly reliable manner.

This problem is solved according to the invention in that the second end of the torsion spring is provided to engage behind an element of the supporting part.

By this, the torsion spring can transmit actuating forces which act in both directions of the control shaft to the supporting part, without being able to become detached from the supporting part on its own. Vibration in the motor vehicle likewise no longer leads to the torsion spring becoming detached from the supporting part. In consequence, the torsion spring is attached to the supporting part in a positively locking manner, and thus particularly reliably. The fact that the torsion spring engages behind an element of the supporting part results in a design which is particularly cost-effective in comparison to a screwed joint.

According to an advantageous development of the invention, the way in which the attachment of the torsion spring to the supporting part is designed is physically particularly simple if the second end of the torsion spring is designed such that it surrounds a pin of the supporting part. In consequence, the second end of the torsion spring just needs to be plugged onto the pin of the supporting part for mounting.

According to another advantageous development of the invention, the second end of the torsion spring is held particularly reliably on the supporting part if the second end of the torsion spring is bent in a U-shape and, at its free end, has a spring tongue which points in the direction of the base of the U.

Another advantageous development of the invention contributes to further reducing the costs for the attachment of the torsion spring by the spring tongue being bent away from the torsion spring.

According to another advantageous development of the invention, an easy way to avoid the second end of the torsion spring becoming detached from the pin of the supporting part in the direction of the axis of the pin is for the pin of the supporting part to be designed such that it engages around the second end of the torsion spring.

According to another advantageous development of the invention, the second end of the torsion spring is secured against becoming detached in any direction if the pin of the supporting part has a recess for holding the second end of the torsion spring.

According to another advantageous development of the invention, the torsion spring can easily be secured against tilting if the supporting part has a baseplate for guiding the torsion spring.

According to another advantageous development of the invention, the torsion spring can be prevented from being jammed at one edge of the supporting part if, in its radially outer regions, the supporting part has a plurality of stops for limiting the radial extension of the torsion spring.

According to another advantageous development of the invention, the torsion spring is held reliably on the supporting part even in the event of severe vibration, if the stops are designed such that they engage around the torsion spring.

According to another advantageous development of the invention, the supporting part can be manufactured particularly cost-effectively if the supporting part is manufactured integrally with the stops and the pin.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention allows numerous embodiments. In order to explain the basic principle of the invention further, two of these embodiments are described in the following text and are illustrated in the drawings, in which

FIG. **1** shows a view from above of a load adjustment apparatus according to the invention,

FIG. **2** shows a section illustration through the load adjustment apparatus from FIG. **1**,

FIG. **3** shows an enlarged illustration of an attachment of a torsion spring to a supporting part,

FIG. **4** shows a section illustration through the torsion spring and the supporting part from FIG. **3**, along the line IV—IV,

FIG. **5** shows a further enlarged illustration of an attachment of a torsion spring to a supporting part, and

FIG. **6** shows a section illustration through the torsion spring and the supporting part from FIG. **5**, along the line V—V.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. **1** shows a load adjustment apparatus according to the invention, having a supporting part **2** which is mounted on a housing stub **1** such that it can pivot. A control shaft **3** which may be, for example, a throttle valve shaft having a throttle valve (which is not illustrated) is mounted in the center of the housing stub **1**, likewise such that it can pivot. The control shaft **3** (which, for example, is welded to the supporting part **2** or forms a physical unit) is connected via a torsion spring **4** to the supporting part **2** and can be pivoted by a reversible actuating drive **5** via a gearbox which, in order to simplify the drawing, is not illustrated. Furthermore, the actuating drive **5** has a driver **6** for deflecting a pivoting arm **7** of the supporting part **2**. The supporting part **2** has a stop arm **8**, which limits the movement of the supporting part **2** between a minimum load stop **9** and an emergency running stop **10**. The supporting part **2** has a baseplate **11** for guiding the torsion spring **4** and, in its radially outer regions, a plurality of stops **12** to **14** in order to limit the radial extension of the torsion spring **4**.

For attachment of the torsion spring **4**, the control shaft **3** has a slot **15**, into which one end of the torsion spring **4** is inserted. The second end of the torsion spring **4** is bent in a U-shape and has a spring tongue **16**, which points in the direction of the base of the U, in order to engage behind a pin **17** of the supporting part **2**. For mounting the second end of the torsion spring **4** on the supporting part **2**, the open end of the U is pressed over the pin **17** until the spring tongue **16** snaps in behind the pin **17**. In consequence, the torsion spring **4** can transmit forces in both rotation directions to the control shaft **3**.

FIG. **2** uses a section illustration along the line II—II in FIG. **1** to show that the stops **12** to **14** and the pin **17** are bent radially inward at their end facing away from the baseplate **11** for the torsion spring **4**. In consequence, the torsion spring **4** is held on the baseplate **11** and is prevented from falling out of the slot **15** in the control shaft **3**.

FIG. **3** shows a further embodiment of the attachment of the torsion spring **4** to the supporting part **2**. The supporting part **2** has a pin **18**, which is arranged at right-angles to the baseplate **11**. One end of a torsion spring **4**, which is bent in a U-shape, engages around the pin **18**. The end of the torsion spring **4** has a bend **19** in order to engage in a recess **20** in the pin **18**.

FIG. **4** uses a section illustration along the line IV—IV in FIG. **3** to illustrate the attachment of the torsion spring **4** to the pin **18**. This shows that the bend **19** is formed by one corner of the free end of the torsion spring **4**.

It can be seen in FIG. **5** that the pin **17** of the supporting part **2** is designed such that it engages around the second end of the torsion spring **4**. For this purpose, the torsion spring **4** has an incline **21** at its second end in the longitudinal direction. The pin **17** has a bend **22** which is formed, for example by stamping, from the originally straight pin **17**. The incline **21** on the torsion spring **4** and the incline on the bend **22** run parallel, with the bend **22** engaging over the incline **21** of the torsion spring, so that, after being inserted, the torsion spring **4** is fixed in position, loaded by the interaction of the incline **21** and bend **22** which engages over it.

FIG. **6** uses a section illustration along the line V—V in FIG. **5** to show the attachment of the torsion spring **4** to the pin **17**. It can be seen in this case that the bend **22** engages over the second end of the torsion spring **4**. The installation process is carried out, for example, in such a manner that the torsion spring is held prestressed by an installation tool and the U-shaped second end (when looking at FIG. **6** from the left) is moved to be at a distance from the pin **17**, and is then moved to the side so that the incline **21** passes under the bend **22**. Once the installation tool is removed (if appropriate, once the first end of the torsion spring has also been fixed in position), the torsion spring **4** is subject to its nominal load and, in consequence, pulls the incline **21** further under the bend **22** until the fixing position is reached.

LIST OF REFERENCE SYMBOLS

1. Housing stub
2. Supporting part
3. Control shaft
4. Torsion spring
5. Actuating drive
6. Driver
7. Pivoting arm
8. Stop arm
9. Minimum load stop
10. Emergency running stop
11. Baseplate
12. Stop
13. Stop
14. Stop
15. Slot
16. Spring tongue
17. Pin
18. Pin
19. Bend
20. Recess
21. Incline
22. Bend

What is claimed is:

1. A load adjustment apparatus having an actuating element which controls power of an internal combustion engine, is designed in particular as a throttle valve and is arranged on a control shaft, wherein the control shaft is driven by a reversible actuating drive which is pivotal between a minimum load position and a full load position, a single torsion spring constituted as a return spring prestressing the control shaft in the minimum load direction and as an emergency running spring prestressing the control shaft against an emergency running stop, a first end of said torsion spring being connectable to the control shaft and a second end of said torsion spring being connectable to an arm of a supporting part which arm is movable between a minimum load stop and the emergency running stop, wherein the second end of the torsion spring engages around a pin of the supporting part, wherein the second end of the torsion spring has an incline with respect to a longitudinal direction of the second end of the torsion spring, and the pin has an engaging bend.

2. The load adjustment apparatus as claimed in claim **1**, wherein the second end of the torsion spring surrounds said pin of the supporting part.

3. The load adjustment apparatus as claimed in claim **1**, wherein the second end of the torsion spring is bent in a U-shape, with a base and a free end opposite the base and, at the free end of the torsion spring, has a spring tongue which points in the direction of the base of the U.

4. The load adjustment apparatus as claimed in claim **3**, wherein the spring tongue is bent away from the torsion spring.

5. The load adjustment apparatus as claimed in claim **1**, wherein the pin of the supporting part has a recess for holding the second end of the torsion spring.

6. The load adjustment apparatus as claimed in claim **1**, wherein the supporting part has a baseplate for guiding the torsion spring.

7. The load adjustment apparatus as claimed in claim **1**, wherein, in radially outer regions of the apparatus, the supporting part has a plurality of stops for limiting the radial extension of the torsion spring.

8. The load adjustment apparatus as claimed in claim **7**, wherein the stops engage around the torsion spring.

9. The load adjustment apparatus as claimed in claim **7**, wherein the supporting part is integral with the stops and the pin.

10. The load adjustment apparatus as claimed in claim **1**, wherein the bend of the pin has an incline with respect to said longitudinal direction, said incline of said bend engages thereunder said incline of said spring, said inclines being inclined with respect to an axis of said pin, thereby securing engagement of the torsion spring against vibrations in the longitudinal direction and axial direction.

11. The load adjustment apparatus as claimed in claim **10**, wherein the second end of the torsion spring surrounds said pin of the supporting part.

12. The load adjustment apparatus as claimed in claim **10**, wherein the supporting part has a baseplate for guiding the torsion spring.

13. The load adjustment apparatus as claimed in claim **11**, wherein, in radially outer regions of the apparatus, the supporting part has a plurality of stops for limiting the radial extension of the torsion spring.

14. The load adjustment apparatus as claimed in claim **13**, wherein the stops engage around the torsion spring.

15. The load adjustment apparatus as claimed in claim **13**, wherein the supporting part is integral with the stops and the pin.

16. The load adjustment apparatus as claimed in claim **10**, wherein the bend is a stamped part of the pin.

17. The load adjustment apparatus as claimed in claim **10**, wherein said inclines are planar surfaces.

18. The load adjustment apparatus as claimed in claim **10**, wherein said inclines are parallel to each other.

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